Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge
Quarterly Update Report – June 2011

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Overview

This update is a summary of activities since the previous status report of April 2011 on the implementation of the Refuge's Enhanced Water Quality Monitoring and Modeling Program. A project overview, and other detailed information about the program can be found at: http://sofia.usgs.gov/lox_monitor_model/. The primary objective of this overall program (Brandt et al. 2004) focuses on providing information for use in ecological management of the Refuge (e.g., USFWS 2007a, b; USFWS 2009; USFWS 2010a, b).

The Refuge's monitoring component of this program also addresses one of the Consent Decree Principals recommendations (17 December 2003):

> ***B. Enhancing Monitoring of the Refuge***
> *Design and implement an enhanced monitoring program to improve spatial and temporal understanding of factors related to phosphorus dynamics.*

The Refuge's modeling component of this program also addresses several of the Consent Decree Principals recommendations (17 December 2003):

> ***C. Modeling of the Refuge***
> *1. Develop a water quality/hydraulic model for the Refuge with a phosphorus cycling component.*
> *2. Evaluate issues associated with phosphorus loads and transports within the L-40 and L-7 canals.*
> *3. Develop and track a simple phosphorus mass-balance model for the Refuge.*

Information Availability

Through collaboration with USGS, information from the Refuge's Enhanced Water Quality Monitoring and Modeling Program has been made available on the USGS' SOFIA web site at: http://sofia.usgs.gov/lox_monitor_model/.

Final data for monthly samples through May 2006 are publicly posted on DBHYDRO by the SFWMD at http://my.sfwmd.gov/dbhydroplsql/show_dbkey_info.main_page. Data for June 2006-June 2011 are posted on the Technical Oversight Committee's web site at https://my.sfwmd.gov/portal/page/portal/pg_grp_sfwmd_era/pg_sfwmd_era_tech

overcommittee. This report includes information from samples collected through June 2011.

Water Quality Data Analyses Update

Primary efforts for this quarter involved exploring mechanisms to continue translating information from the program to aid in Refuge management decisions, and working on the program's Annual Report.

Monitoring Update (April – June 2011)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at seven stations in April and five stations in May and June 2011 (**Table 1**).

Total phosphorus data available to date for July 2010 through June 2011 are presented in **Table 1**. Maps of stations where samples were collected for April through June 2011 are presented in **Figures 2-4**.

Conductivity sonde deployment information for July 2010 through June 2011 is presented in **Table 2**.

Modeling Update

During the third quarter of 2011, the Refuge modeling team continued a study comparing performance of the 39-Compartment Refuge model with the MIKE-FLOOD Refuge model. This comparison will be the major effort documented in an MS thesis that should be completed in the University of Louisiana fall semester. We plan to use this comparison to guide model selection for future applications. This work will also be reported in a journal publication. Efforts continued on models documentation and journals publications development.

Next Steps

The next steps for this program include additional efforts on the Annual Report, and additional model development and application.

References

Brandt, L.A., Harwell, M., Waldon, M. (2004) Work Plan: Water Quality Monitoring and Modeling for the A.R.M. Loxahatchee National Wildlife Refuge: 2004-2006. Prepared for the A.R.M. Loxahatchee National Wildlife Refuge. April, 2004. 33 pp.

USFWS. (2007a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Monitoring and Modeling Program – 2nd Annual Report – February 2007. LOXA06-008, U.S. Fish and Wildlife Service, Boynton Beach, FL. 183 pp.

USFWS. (2007b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 3rd Annual Report – October 2007. LOXA07-005, U.S. Fish and Wildlife Service, Boynton Beach, FL. 116 pp.

USFWS. (2009) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 4th Annual Report – July 2009. LOXA09-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 106 pp.

USFWS. (2010a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 5th Annual Report – September 2010. LOXA08-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 43 pp.

USFWS. (2010b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 6th Annual Report – October 2010. LOXA09-011, U.S. Fish and Wildlife Service, Boynton Beach, FL. 42 pp.

Table 1. Total phosphorus data (ppb) available for July 2010 – June 2011 from the Enhanced Water Quality Monitoring Program for: (a) marsh, and (b) canal stations for the A.R.M. Loxahatchee National Wildlife Refuge. Graphical representation of station locations are shown in Figure 1.

a) Marsh stations

Marsh Station	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11
LOXA101	–	32	22	16	14	20	12	–	–	–	–	–
LOXA102	–	–	16	12	8	–	–	–	–	–	–	–
LOXA103	–	–	20	12	10	10	–	–	–	–	–	–
LOXA105	19	24	26	21	16	8	–	–	–	–	–	–
LOXA106	15	14	15	16	9	3	–	–	–	–	–	–
LOXA107	–	–	19	13	9	–	–	–	–	–	–	–
LOXA108	7	–	9	8	5	9	–	–	–	–	–	–
LOXA109	9	10	11	11	7	3	7	8	–	–	–	–
LOXA110	10	10	7	10	8	6	–	–	–	–	–	–
LOXA111	6	8	7	9	6	U	41	10	51	–	–	–
LOXA112	17	11	10	10	7	5	–	–	–	–	–	–
LOXA113	5	8	5	10	5	6	4	–	–	–	–	–
LOXA114	8	6	5	12	U	U	5	–	–	–	–	–
LOXA117	28	17	33	22	15	9	12	14	–	–	–	–
LOXA118	10	11	11	13	9	6	7	9	–	–	–	–
LOXA119	9	9	7	12	7	5	14	17	–	–	–	–
LOXA120	7	7	4	8	7	5	6	10	13	29	–	–
LOXA122	18	17	21	19	13	9	13	13	–	–	–	–
LOXA124	16	13	18	13	10	14	7	15	–	–	–	–
LOXA126	18	18	20	13	12	16	5	7	–	–	–	–
LOXA127	18	12	9	7	8	11	–	9	–	–	–	–
LOXA128	6	7	4	9	4	U	–	–	–	–	–	–
LOXA130	14	8	26	15	11	14	5	13	21	–	–	–
LOXA131	13	12	11	9	7	9	5	9	–	–	–	–
LOXA133	–	17	46	20	15	28	–	–	–	–	–	–
LOXA134	13	11	21	16	11	11	5	12	–	–	–	–
LOXA136	–	–	33	23	–	21	11	17	–	–	–	–
LOXA137	8	8	18	17	11	12	11	14	–	–	–	–
LOXA138	7	8	9	17	6	8	–	–	–	–	–	–
LOXA139	9	6	7	7	8	9	–	–	–	–	–	–
LOXA140	–	10	18	12	11	16	–	–	–	–	–	–
LOXA141	12	13	13	20	15	10	11	61	12	21	–	–
MAX	28	32	46	23	16	28	41	61	51	29	–	–
MIN	5	6	4	7	4	3	4	7	12	21	–	–

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 1 cont.

b) Canal stations

Canal Station	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11
LOXA104	26	34	31	27	28	20	21	29	32	33	40	32
LOXA115	23	34	33	30	27	23	20	22	23	33	32	45
LOXA129	39	37	32	28	28	25	30	41	63	70	71	79
LOXA132	60	36	38	29	30	26	39	43	59	66	74	79
LOXA135	62	32	20	21	27	28	32	33	46	53	62	77
MAX	62	37	38	30	30	28	39	43	63	70	74	79
MIN	23	32	20	21	27	20	20	22	23	33	32	32

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 2. July 2010 – June 2011 conductivity sonde deployment information, separated by transect, for the A.R.M. Loxahatchee National Wildlife Refuge. X = data collected from sonde deployment during that month. Graphical representation of station locations are shown in Figure 1.

	2010						2011					
Site ID	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
LOXA104	X	X	X	X	X	X	X	X	X	X	X	X
LOXA105	X		X		X		X		X		X	
LOXA106	X		X		X		X		X		X	
LOXA107	X		X		X		X		X		X	
LOXA108	X		X		X		X		X		X	
LOXA111		X		X		X		X		X		X
LOXA112		X		X		X		X		X		X
LOXA113		X		X		X		X		X		X
LOXA114		X		X		X		X		X		X
LOXA115	X	X	X	X	X	X	X	X	X		X	X
LOXA116	X		X	X		X		X	X			
LOXA117	X		X	X		X		X	X			
LOXA118	X		X	X		X		X	X			
LOXA119	X		X	X		X		X	X			
LOXA120	X		X	X		X		X	X			
LOXA126		X		X		X		X		X		X
LOXA127		X		X		X		X		X		X
LOXA128		X		X		X		X		X		X
LOXA129	X	X	X	X	X	X	X	X	X	X	X	X
LOXA130			X		X		X		X		X	
LOXA131			X		X		X		X		X	
LOXA132	X	X	X	X	X	X	X	X	X	X	X	X
LOXA133			X		X		X		X		X	
LOXA135	X	X	X	X	X	X	X	X	X	X	X	X
LOXA136			X		X		X		X		X	
LOXA137			X		X		X		X		X	
LOXA138			X		X		X		X		X	
LOXA139			X		X		X		X		X	
LOXA142	X		X		X	X		X		X	X	
LOXA143		X		X		X		X	X			
LOXA144		X		X		X		X	X			
LOXA145		X		X		X		X	X			
LOXA146		X		X		X		X	X			
LOXA147	X							X	X		X	
LOXA148		X		X		X		X	X		X	
LOXA149		X		X		X		X	X		X	
LOXA150		X		X		X		X	X		X	
LOXA151	X	X	X	X	X	X	X	X	X	X	X	X
LOXA152	X	X	X	X	X	X	X	X	X	X	X	X
LOXA153	X	X	X	X	X	X	X	X	X	X	X	X
I-8C	X	X	X		X		X	X	X	X	X	X
LOX04			X		X		X		X		X	
LOX06		X		X		X		X		X		X
LOX07		X		X		X		X		X		X
LOX08		X		X		X		X		X		X
LOX09		X		X		X		X		X		X
LOX10		X		X		X		X		X		X
LOX15		X		X		X		X	X		X	

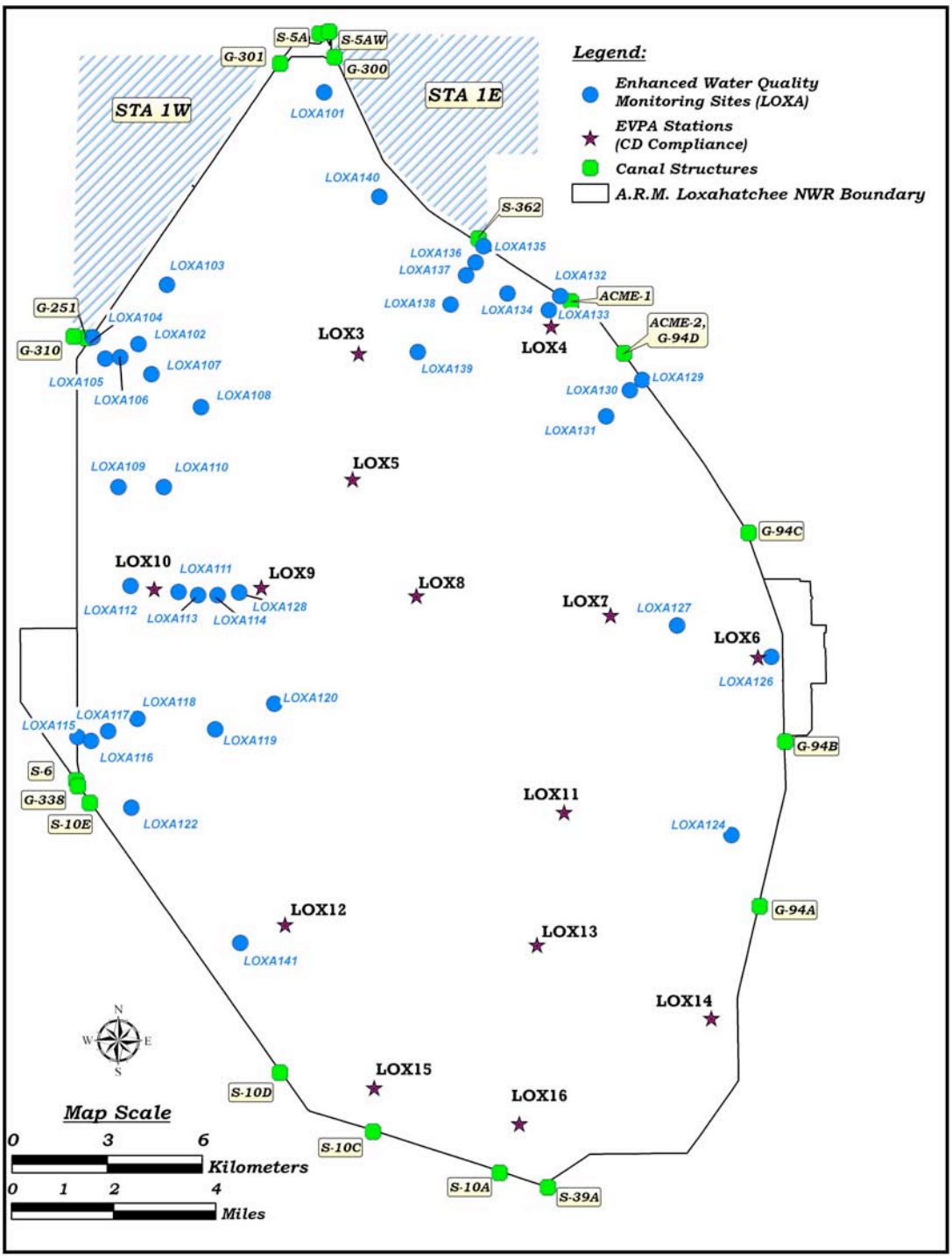

Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

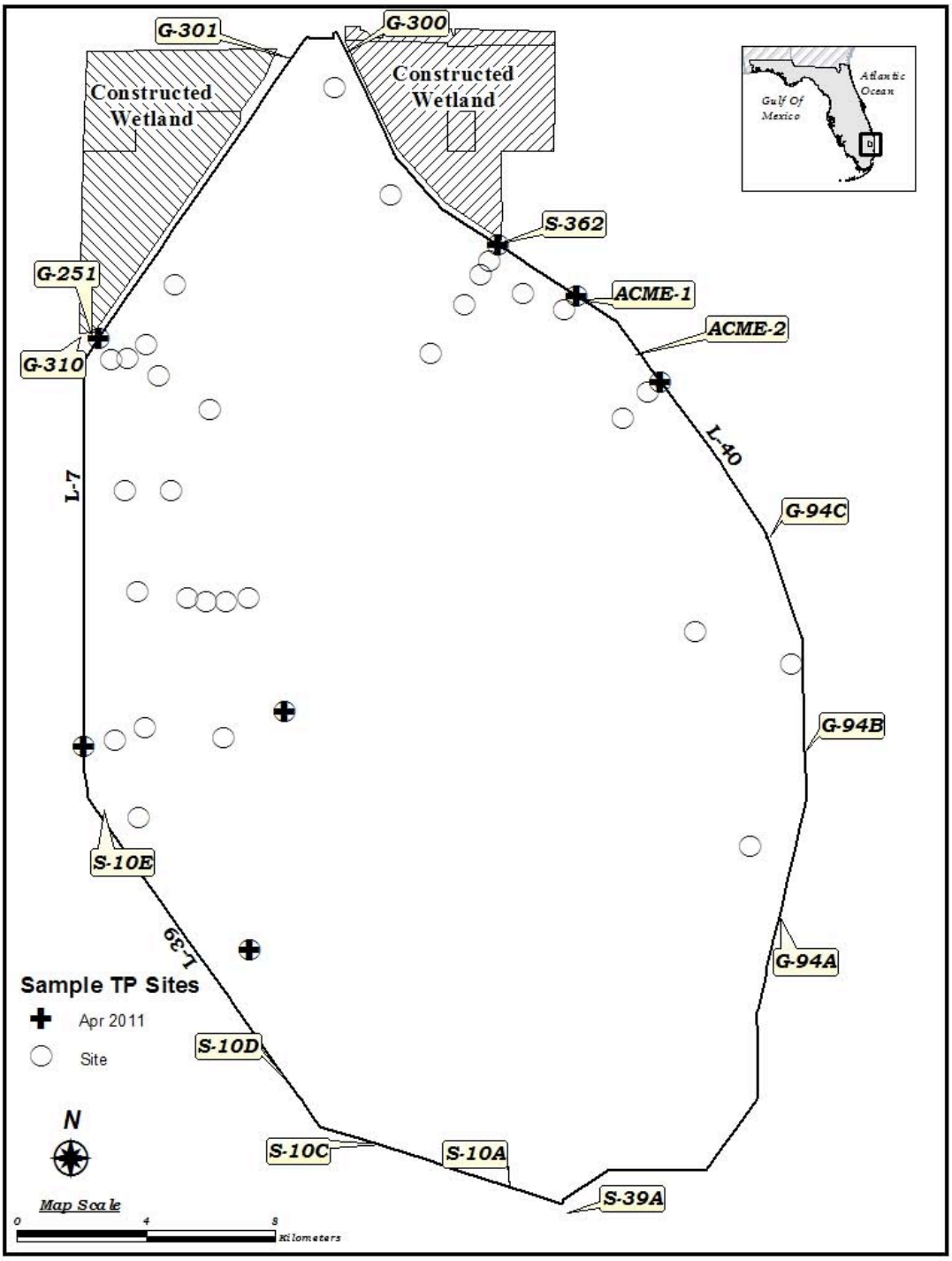

Figure 2. April 2011 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not

sampled is that it has less than 10 cm of clear water column representative of that area.

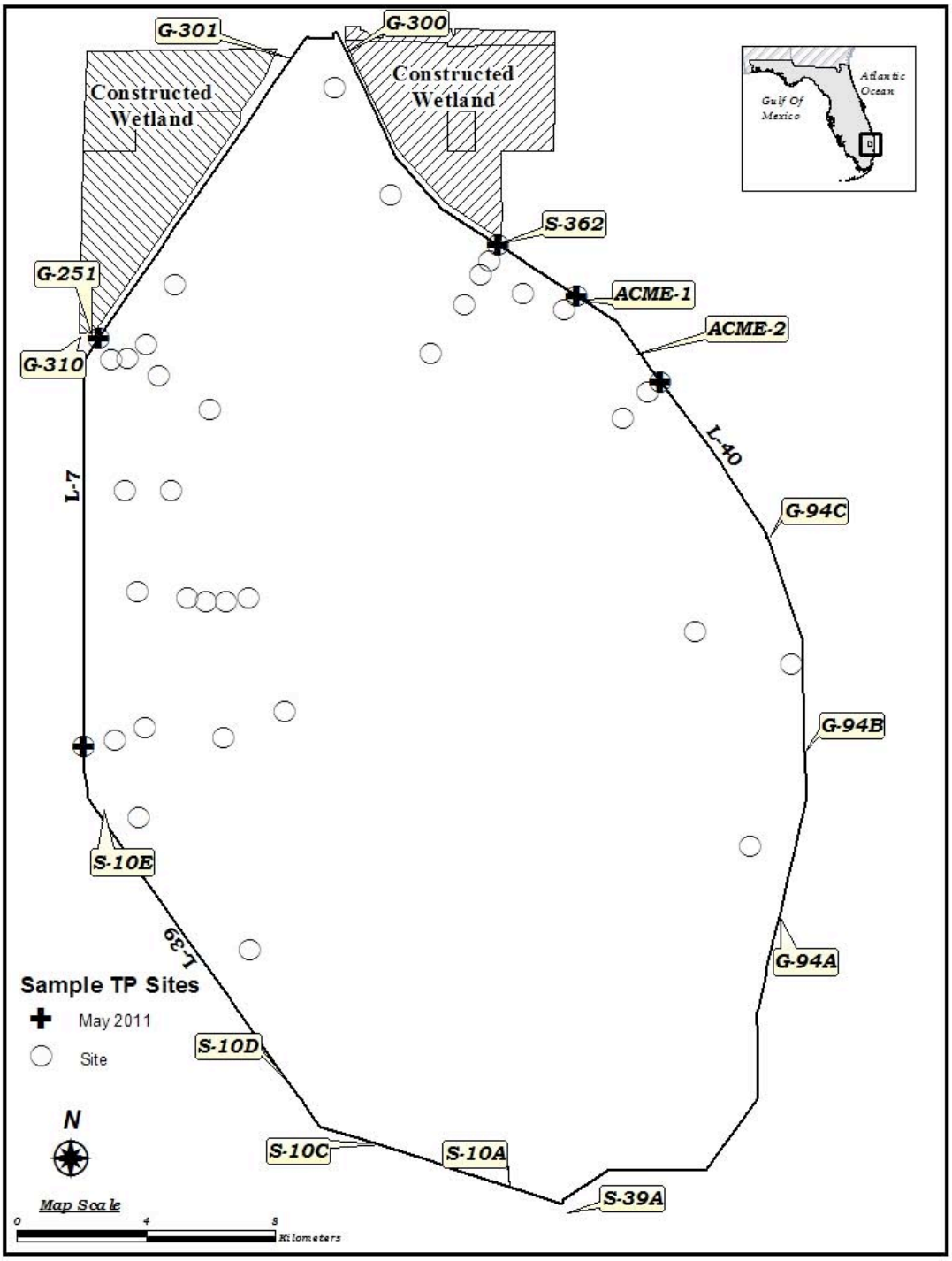

Figure 3. May 2011 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not

sampled is that it has less than 10 cm of clear water column representative of that area.

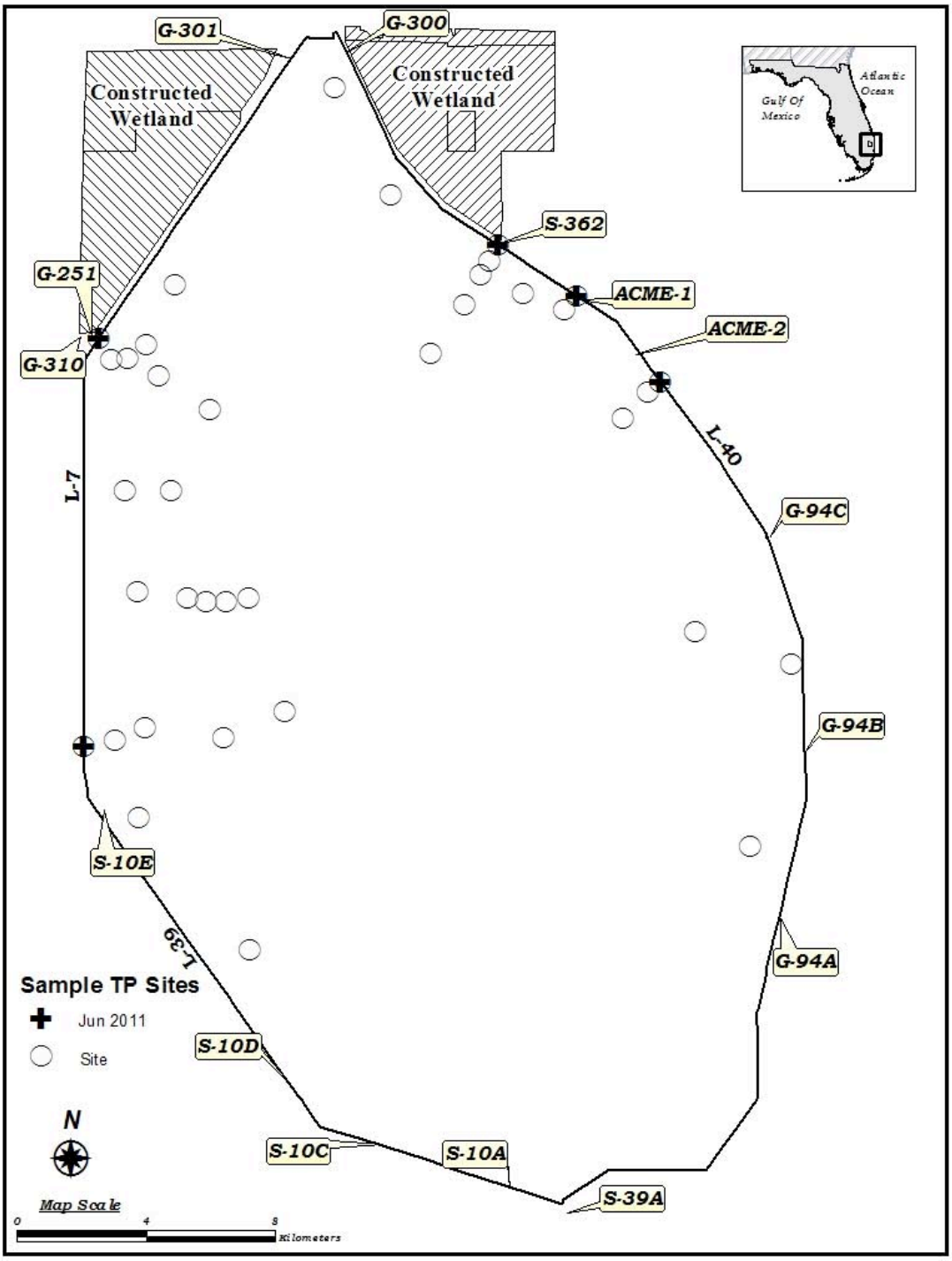

Figure 4. June 2011 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not

sampled is that it has less than 10 cm of clear water column representative of that area.